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Notice of Allowability	Application No.	Applicant(s)	
	10/715,319	LANG, FRED D.	
	Examiner	Art Unit	
	Manuel L. Barbee	2857	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *papers filed 8 October 2005*.

2. ☒ The allowed claim(s) is/are *1-61 and 64-76*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

DETAILED ACTION

Terminal Disclaimer

1. The terminal disclaimer filed on 8 October 2005 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of US Patent No. 6,651,035 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Allowable Subject Matter

2. Claims 1-61 and 64-76 are allowed.

3. The following is an examiner's statement of reasons for allowance: None of the prior art teaches a method for quantifying the operation of a recovery boiler burning black liquor fuel bearing sodium compounds that includes monitoring the recovery boiler burning black liquor fuel bearing sodium compounds using one of the Input/Loss methods, developing a mathematical model of the combustion process incorporating terms commonly associated with black liquor fuel combustion including sodium compounds and terms associated with sources of working fluid flows into the combustion gas path including tube leakage resulting in a stoichiometric model of the combustion process and determining the tube leakage based on the stoichiometric model of the combustion process, as shown in claim 1.

None of the prior art teaches a method for quantifying the operation for a recovery boiler burning black liquor fuel that includes developing a mathematical model of the combustion process, selecting a set of minimization techniques applicable to the recovery boiler and a set of routing inputs and convergence criteria to the minimization

techniques, selecting a Choice Operating Parameter of tube leakage flow rate, selecting a set of Choice Operating Parameters, determining a set of System Effect Parameters applicable to the recovery boiler, determining a set of Reference System Effect Parameters, determining an objective function, which allows minimization of differences between the set of System Effect Parameters and the set of Reference System Effect Parameters and determining the tube leakage by minimizing the objective function and reporting the rube leakage flow rate, as shown in claim 5.

None of the prior art teaches a method for quantifying the operation of a thermal system burning fossil fuel that includes selecting one of the Input/Loss methods, selecting a set of effluent concentrations associated with the thermal system based on available instrumentation resulting in a set of available plant effluent concentrations, obtaining a ratio of effluent concentrations based on an effluent concentration obtained before the air leakage and on an effluent concentration obtained after the air leakage and establishing an air pre-heater leakage factor which describes the effects of the air leakage into the thermal system based on the obtained ratio, as shown in claim 17.

None of the prior art teaches a method for quantifying the operation for a recovery boiler burning black liquor fuel that includes developing a mathematical model of the combustion process, obtaining a set of Choice Operating Parameters, obtaining a set of Reference Fuel Characteristics, obtaining a fuel chemistry of the fuel being combusted by the recovery boiler using one of the Input/Loss Methods, the mathematical model of the combustion process, the set of Choice Operating Parameters, and the set of Reference Fuel Characteristics, said fuel chemistry resulting

in a set of fuel concentrations, establishing a set of concentrations limits for each fuel constituent based on Reference Fuel Characteristics, testing the set of fuel concentrations against the set of concentration limits resulting in a trip mechanism indicating the stoichiometric reason how a heat exchanger leaks a tube lekage flow rate into the combustion gas path and reporting the trip mechanism, as shown in claim 23.

None of the prior art teaches a method for quantifying the operation for a recovery boiler burning black liquor fuel that includes developing a mathematical model of the combustion process, selecting a set of minimization techniques, processing a set of routing inputs and convergence criteria to the minimization techniques, assuming a tube leakage flow rate is zero, selecting a set of routine Choice Operating Parameters, determining a set of System Effect Parameters, determining a set of Reference System Effect Parameters applicable to the set of System Effect Parameters, determining an objective function applicable to the recovery boiler, the set of routine Choice Operating Parameters, the set of System Effect Parameters and the set of Reference System Effect Parameters, optimizing the set of routine Choice Operating Parameters based on the mathematical model of the combustion process, the set of minimization techniques, and the objective function such that convergence is met resulting in a set of converged Choice Operating Parameters, determining a fuel chemistry of the fuel being combusted by the recovery boiler using one of the Input/Loss methods, the mathematical model of the combustion process, the set of converged Choice Operating Parameters and Reference Fuel Characteristics resulting in a fuel elemental composition, a fuel ash fraction and a fuel water fraction said composition and fractions resulting in a set of fuel

concentrations, establishing a set of concentration limits, testing the set of fuel concentrations against the set of concentration limits resulting in a trip mechanism, as shown in claim 24.

None of the prior art teaches a method for quantifying the operation of a recovery boiler burning black liquor fuel that includes selecting neural network technology applicable to the boiler, selecting a set of routine inputs and database for the neural network technology, selecting a set of Choice Operating Parameters including tube leakage flow rate, and wherein the set of determining the tube leakage includes optimizing the set of Choice Operating Parameter including tube leakage flow rate using the neural network technology and the set of routine inputs and database such that convergence is met resulting in a set of converged Choice Operating Parameters including a tube leakage flow rate and reporting the tube leakage flow rate, as shown in claim 26.

None of the prior art teaches a method for quantifying the operation of a recovery boiler burning black liquor fuel when being monitored by one of the Input/Loss methods coincident with one of its heat exchangers leaking its working fluid into the combustion gas path producing a tube leakage flow, the method for quantifying the operation by identification of the leaking heat exchanger that includes identifying a set of heat exchangers descriptive of the recovery boiler as employed to transfer net energy flow to the working fluid from the combustion gases resulting in a set of identified heat exchangers, obtaining a set of Operating Parameters applicable to the set of identified heat exchangers, analyzing a set of net energy flows to the working fluid from the

combustion gases based on the set of identified heat exchangers, the set of Operating Parameters and the tube leakage flow rate, each analyzed set descriptive of the recovery boiler and wherein each analyzed set the tube leakage flow rate is assigned to a different heat exchanger, resulting in an analyzed set of heat exchangers, determining a reference key comparative parameter for the recovery boiler, obtaining a set of key comparative parameters associated with each identified heat exchanger, applicable with the reference key comparative parameter, and based on the analyzed set of heat exchangers, determining a set of deviations between the set of key comparative parameters and the reference key comparative parameter, determining an identification of the leaking heat exchanger based on the set of deviations, and reporting to the operator of the recovery boiler the identification of the leaking heat exchanger such that corrective action may take place, as shown in claim 30.

None of the prior art teaches a method for quantifying the operation of a recovery boiler burning black liquor fuel bearing sodium compounds that includes monitoring the recovery boiler using one of the Input/Loss methods, developing a mathematical model of the combustion process incorporating terms commonly associated with black liquor fuel combustion and sources of working fluid flows into the combustion gas path including tube leakage and determining the tube leakage based on the mathematical model of the combustion process, as shown in claim 35.

None of the prior art teaches a method for quantifying the operation of a recovery boiler burning a black liquor fuel in a combustion process through knowledge of when one of its heat exchangers, whose tubes contain working fluid heated by products of

combustion, has a tube leak of working fluid mixing with the products of combustion, the method for quantifying the operation that includes determining a location of the heat exchanger within the recovery boiler with the tube leak based on the working fluid's energy flow by assigning the tube leak to different heat exchangers, as shown in claim 41.

None of the prior art teaches a method for quantifying the operation of a thermal system burning a fossil fuel that includes developing an explicit mathematical model of the combustion process before online operation, operating online while using the explicit mathematical model, measuring a set of measurable operating parameters, including at least effluent concentrations of oxygen and carbon dioxide, downstream of the heat exchangers/combustion region of the thermal system, obtaining an effluent concentration of water if reference fuel characteristics indicate fuel water is not predictable, obtaining an air pre-heater leakage factor and calculating fuel chemistry as a function of the explicit mathematical model of the combustion process, the set of measurable operating parameters, the obtained effluent water and the air pre-heater leakage factor, as shown in claim 47.

None of the prior art teaches a method for quantifying the operation of a recovery boiler burning black liquor fuel that includes obtaining reference fuel characteristics while off-lien, obtaining current measurements of the system's operating parameters while off line and while online performing the steps of measuring the useful output of the system, obtaining fuel data and characteristics, introducing fuel concentrations and heating values to a mathematical model of the recovery boiler, obtaining routine

systems operational parameters, obtaining values of the effluents oxygen, carbon dioxide, water and SO_2, obtaining air pre-heater leakage and dilution factors, computing molar moisture-ash-free fractions of fuel carbon and fuel water as explicit stoichiometric solutions, finding the molar moisture ash-free fractions of fuel nitrogen, oxygen, hydrogen, sulfur, sodium, potassium and chloride, converting the molar moisture-ash-free fuel concentrations to a molar dry base and executing the mathematical model to determine the As-Fired fuel flow, effluent flow, emission rates, boiler efficiency and over-all system thermal efficiency, as shown in claim 50 or similar limitations found in claim 53.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Manuel L. Barbee whose telephone number is 571-272-2212. The examiner can normally be reached on Monday-Friday from 9-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Marc S. Hoff can be reached on 571-272-2216. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

mlb
October 19, 2005

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